TangerineSDR RXM-5001D Receiver Status Update

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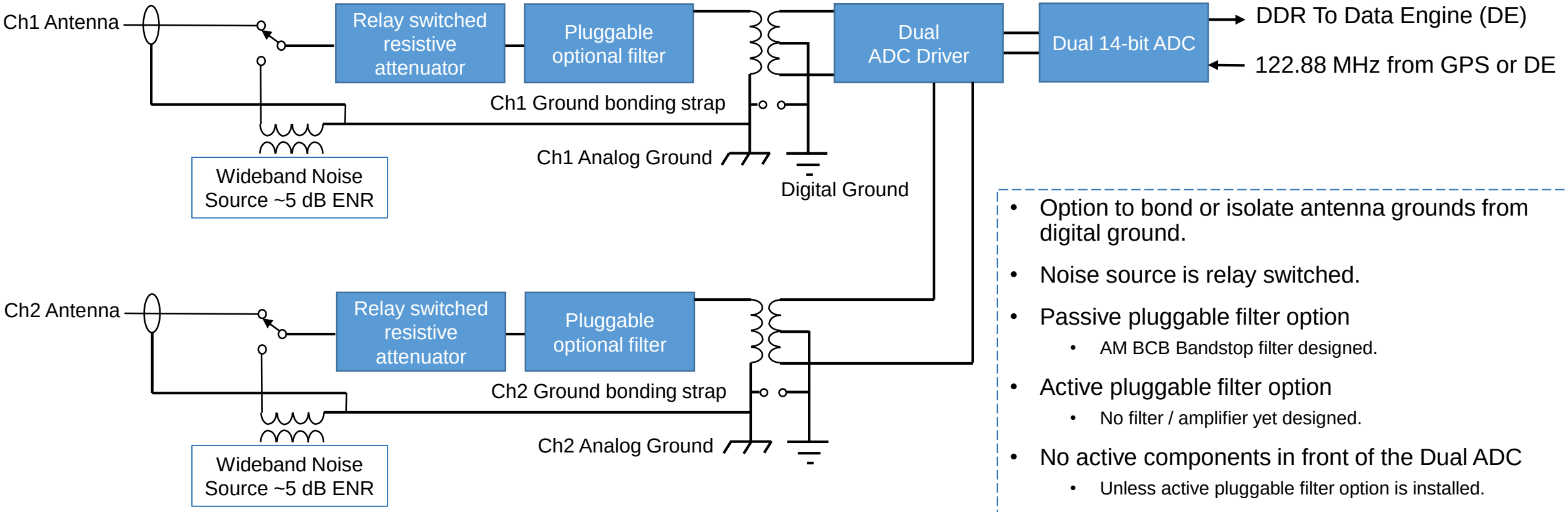
Outline

- High Level diagram
- Status update
- Configurable settings
- Characterization and Calibration

RXM-5001D High Level Diagram

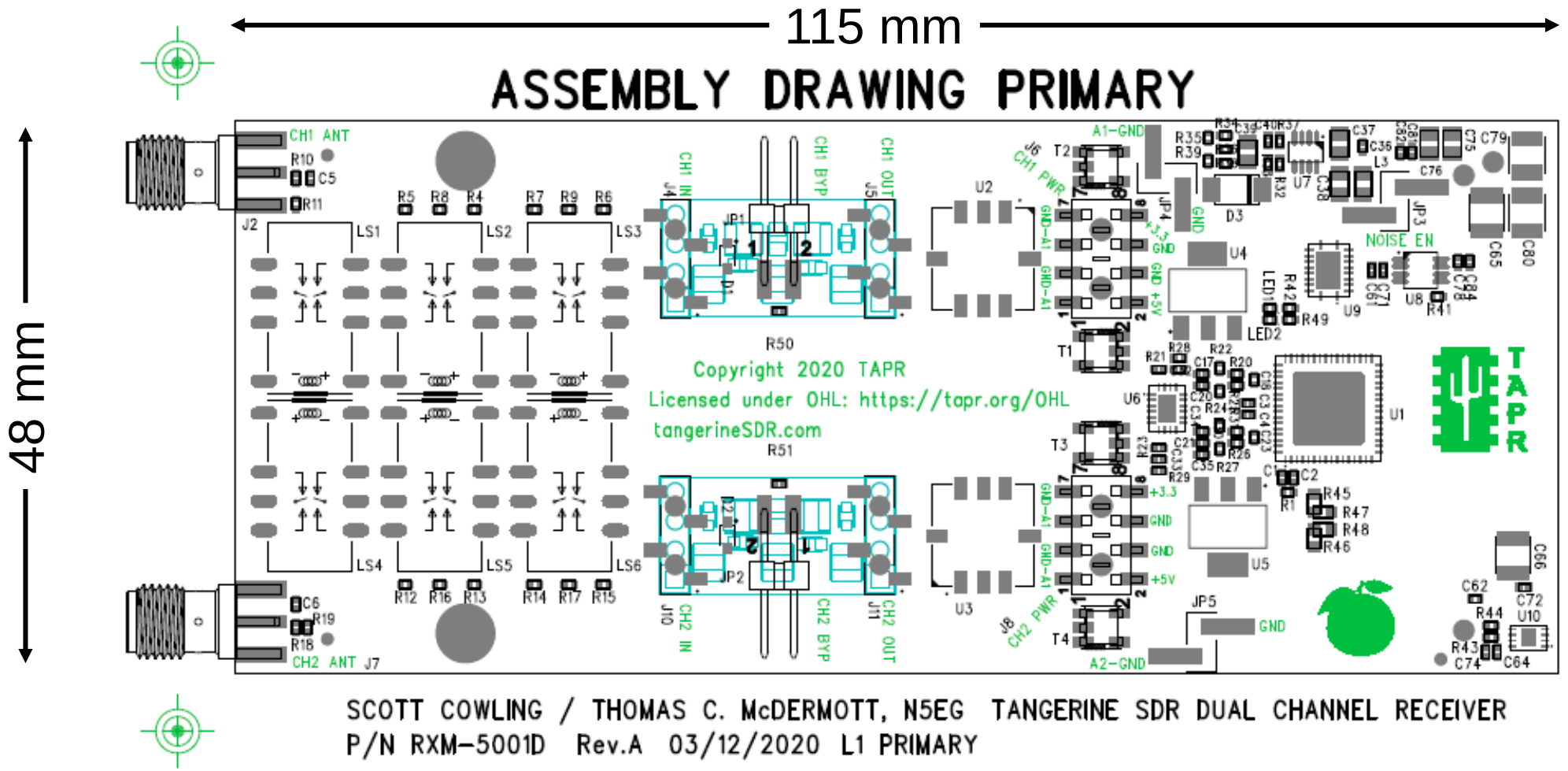


- Option to bond or isolate antenna grounds from digital ground.
- Noise source is relay switched.
- Passive pluggable filter option
  - AM BCB Bandstop filter designed.
- Active pluggable filter option
  - No filter / amplifier yet designed.
- No active components in front of the Dual ADC
  - Unless active pluggable filter option is installed.
- 0 dB / 10 dB / 20 dB / 30 dB attenuator.

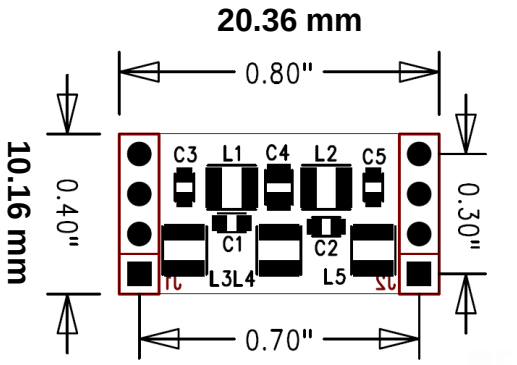
Receiver Status – as of Mar 16, 2020

- Schematic Completed but still being tweaked.
- PCB layout completed but still being tweaked
  - Dependencies on the Data Engine circuit board layout.
- Nothing fabricated or built yet.
- Future Tasks:
    - Assemble first prototype RFM-5001D units,
    - DE completion, checkout, FPGA test firmware,
    - Create Test software (retrieve data buffers, configure ADC, etc.),
    - Measurements and characterization.

Receiver Preliminary Layout



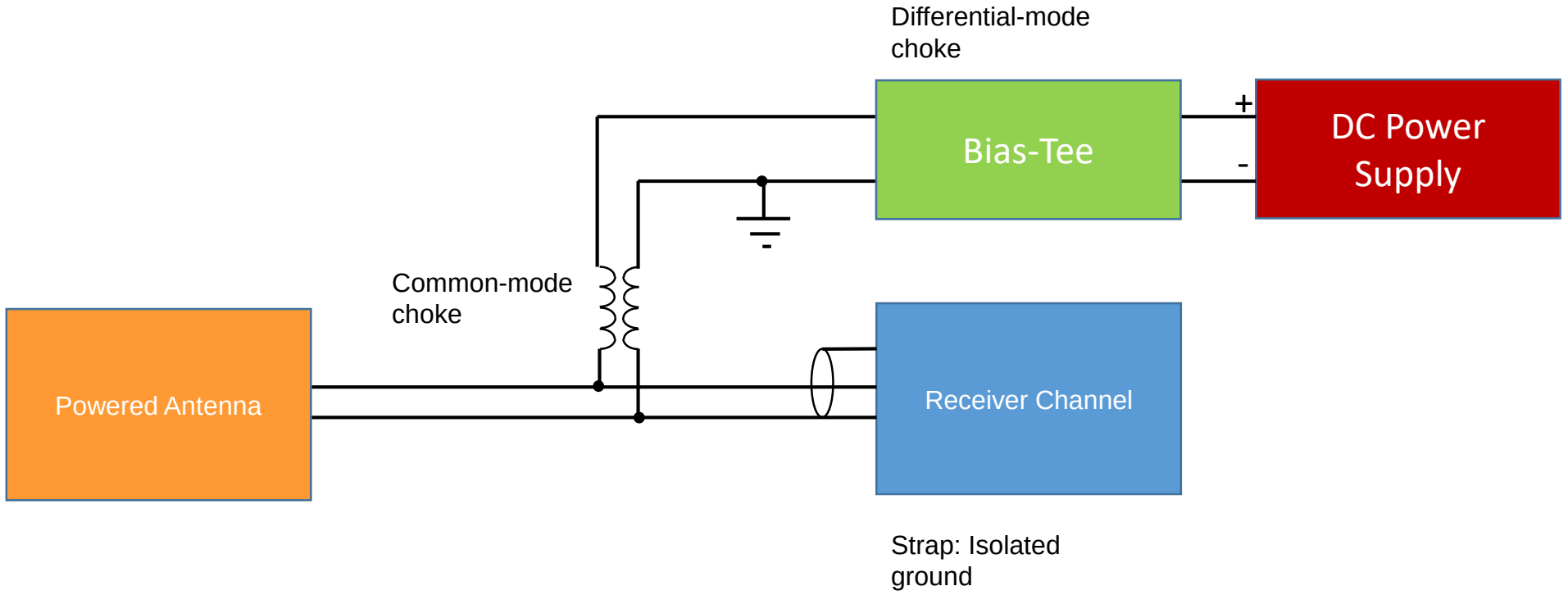
AM BCB (Passive) Filter Layout



Strappable / Configurable Options

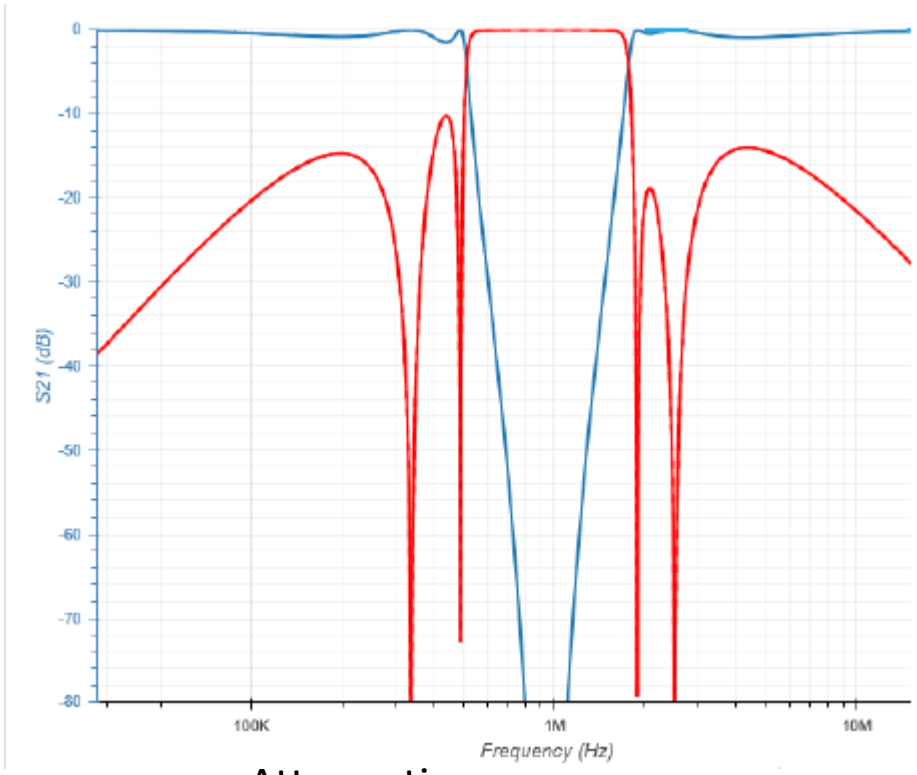
- Bond or isolate grounds.
  - Isolated grounds help reduce common mode signals / noise, important in some applications.
  - Use common-mode choke if externally supplying power to remote antenna amplifier (in addition to Single-inductor bias-Tee).
  - Bonded grounds may be needed in some jurisdictions.
- Noise On / Off.
  - Allows verifying attenuator and filter settings, verifying weak background noise level (Dickie switch).
- Attenuator: 0 dB / 10 dB / 20 dB / 30 dB settings available.

Powered & Isolated Antenna Configuration



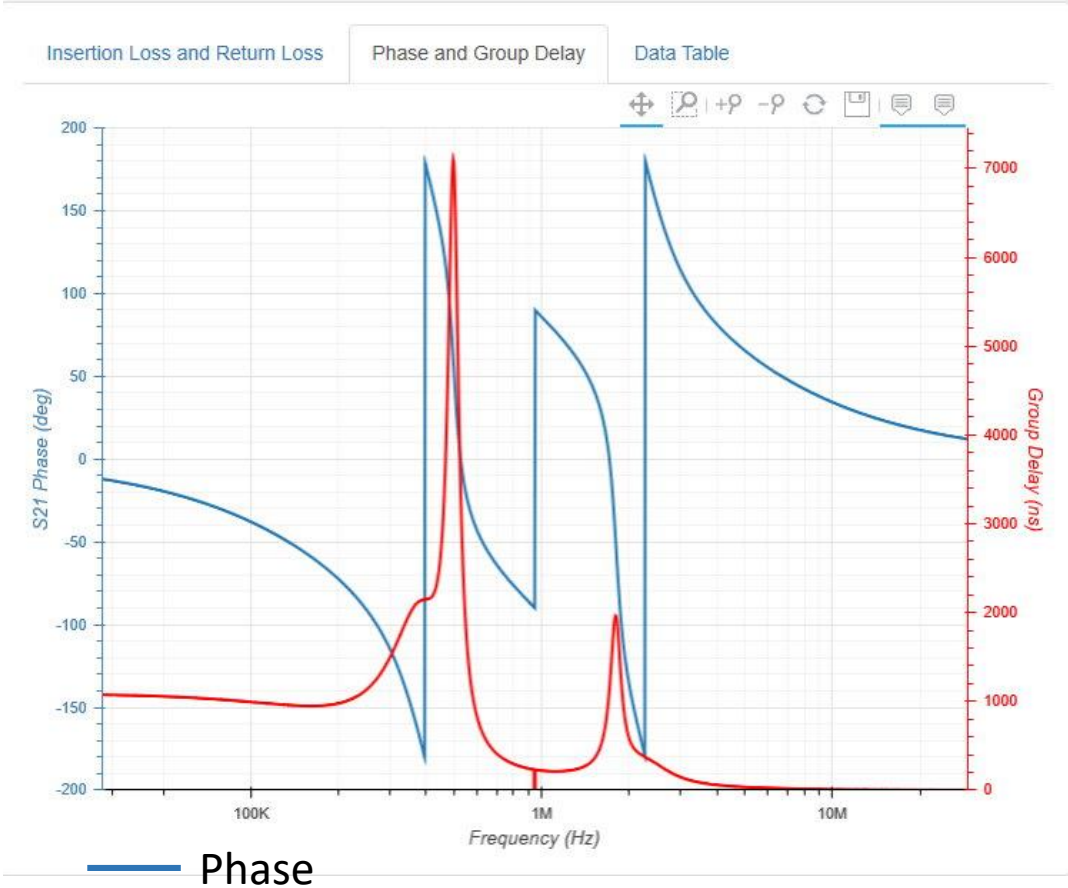
AM BCB Passive Bandstop filter

- Optional pluggable filter. Simulation:



Attenuation

Return Loss



Phase

Group Delay

Characterization and Calibration

- Design Characterization needed [likely similar across units]:
  - Noise source level, frequency response
  - Receiver sensitivity, noise figure, frequency response, phase response, channel isolation, phase noise, spurious responses, others.
  - Receiver channel group delay (primarily the 40 MHz band limiting filter).

- Per-channel Calibration needed [likely different between units]:
  - Pluggable Filter group delay (orders of magnitude larger than band limiting filter).

- Independently removed by the Data Engine or Host Software:
  - Group Delay
    - Multi-channel interferometry.
    - Polarization discrimination.
  - Noise source level, frequency response
    - To provide more accurate background characterization?

Some Interferometry Considerations

1. NCOs on separated receivers need a common time and frequency reference for interferometry.
   - The quality of that reference needs to be agreed by the science community.
2. Downconversion NCO oscillators on separated receivers have different static phase (from each other).
   - Phase offset will jump when the NCO is reprogrammed.
3. Compensation might be needed for things like:
   - RF Filter component tolerance, antenna cable length differences, antenna preamp differences, antenna phase center differences, etc.
4. Wideband measurements might incur dispersion in some cases.
   - Not using AM BCB filter desirable for wideband measurements.
5. Three-antenna Closure Phase[1,2] method ("self-calibration") might be used to compensate for static phase differences.

[1] "A phase sensitive interferometer technique for the measurement of the Fourier transforms of spatial brightness distributions of small angular extent". Jennison, RC, Monthly Notices of the Royal Astronomical Society, Vol. 118, p.27, pub 1958

[2] https://en.wikipedia.org/wiki/Closure_phase